



WM33 & 52

RH & Temperature Transmitter, Wall Mount

User's Manual



Please fill out the form(s) below for each instrument that has been purchased.

Use this information when contacting Michell Instruments for service purposes.

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

Instrument	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	



WM33 & 52

For Michell Instruments' contact information please go to
www.michell.com

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Safety

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. The user must not use this equipment for any other purpose than that stated. Do not apply values greater than the maximum value stated.

This manual contains operating and safety instructions, which must be followed to ensure the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage. Use competent personnel using good engineering practice for all procedures in this manual.

Electrical Safety

The instruments are designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument.

Toxic Materials

The use of hazardous materials in the construction of this instrument has been minimized. During normal operation it is not possible for the user to come into contact with any hazardous substance which might be employed in the construction of the instrument. Care should, however, be exercised during maintenance and the disposal of certain parts.

Repair and Maintenance

The instrument must be maintained either by the manufacturer or an accredited service agent. For Michell Instruments' worldwide offices contact information go to www.michell.com.

Calibration

Michell Instruments recommends an annual calibration for an accuracy requirement of $\pm 2\%$ RH under ambient conditions where temperature is 0 to $+50^{\circ}\text{C}$ ($+32$ to $+122^{\circ}\text{F}$) and relative humidity is 0 to 70% RH. For environments with airborne chemicals or for high humidity and high temperature conditions, Michell recommends more frequent calibration.

Safety Conformity

This product meets the essential protection requirements of the relevant EU directives. Further details of applied standards may be found in the product specification.

EMC Compatibility

The WM33 & 52 relative humidity & temperature transmitters are designed to meet the following European standards:

- EN 61326 (1997) + A1 (1998) + A2 (2001)
- EN 61000-3-2 (1995) + A1 (1998) + A2 (1998) & EN 61000-3-3 (1995)
- Emission: Class B, Immunity: Industrial

Abbreviations

The following abbreviations are used in this manual:

°C	degrees Celsius
°F	degrees Fahrenheit
DC	direct current
"	inch(es)
mA	milliampere
mm	millimeters
%	percentage
oz	ounce(s)
RH	relative humidity
T	temperature
V	Volts
Ω	Ohms

Warnings

The following general warning listed below is applicable to this instrument. It is repeated in the text in the appropriate locations.



Where this hazard warning symbol appears in the following sections it is used to indicate areas where potentially hazardous operations need to be carried out.

1 INTRODUCTION

The WM33 & 52 are wall-mounted units that have the ability to display and provide an output signal of %RH, dew point or absolute humidity and temperature. The WM Series offers excellent measurement accuracy and stability wherever a wall-mounted sensor is required.

There are 3 versions available:

- WM33 analog
- WM52 analog without display
- WM52 digital with or without display



Figure 1 WM33 & 52

1.1 Highlights

- WM33 is designed for low cost HVAC applications
- WM52 with display has digital technology and is designed for accurate measurements in a controlled environment
- Easy to calibrate to maintain high accuracy

1.2 Features

- % RH, dew point, absolute humidity and temperature outputs
- WM52 user selectable 2 line or 4 line display version
- Easy to re-calibrate
- Long term stability: $\pm 1\%$ RH over 12 months
- Quick installation

2 **INSTALLATION**

2.1 **Electrical Connections**

3/4 wire voltage output DC power supply	2 wire mA output DC power supply	3/4 wire voltage output with display DC power supply
<div><div><div>Pin 1</div><div>Pin 2</div></div><div><div></div><div></div><div></div></div><div>Pt100/Pt1000</div></div> <div><div>Pin 2</div><div>Pin 3</div><div>Pin 4</div><div>Pin 5</div></div> <div><div>Output temperature +</div><div>Common ground</div><div>Output RH +</div><div>Power supply V +</div></div>	<div><div><div>Pin 1</div><div>Pin 2</div></div><div><div></div><div></div><div></div></div><div>Pt100/Pt1000</div></div> <div><div>Pin 1</div><div>Pin 2</div><div>Pin 3</div><div>Pin 4</div></div> <div><div>Output temperature -</div><div>Output temperature +</div><div>Output RH +</div><div>Output RH -</div></div>	<div><div>Pin 1</div><div>Pin 2</div><div>Pin 3</div><div>Pin 4</div></div> <div><div>Output temperature +</div><div>Common ground</div><div>Output RH , Dew Point, Absolute Humidity +</div><div>Power supply V+</div></div>
PT direct and Temperature output versions	PT direct and Temperature output versions	

Figure 2 *Electrical Connections*

3 CALIBRATION

- **Calibration certifications:** In addition to the normal calibration procedure, each transmitter can be supplied with its own traceable calibration certificate. Please ask Michell Instruments or your local distributor for more information.
- **Calibration interval time:** Under normal ambient conditions (0 to 50°C, 0 to 70% RH) and for accuracy of $\pm 2\%$ RH, an annual calibration is recommended. For accuracy of $\pm 5\%$ RH a calibration is recommended every five years. For environments with airborne chemicals or of high humidity and high temperature conditions more frequent calibration is recommended.

If re-adjustment is necessary, refer to Sections 3.1, 3.2 and 3.3, and also see the drawings of the circuit boards for the location of the potentiometers (*Figures 3 to 6*).

A humidity generator, (Michell Instruments S503, S904 or Optical), used in combination with a general reference handheld hygrometer, is ideal for a quick and accurate calibration. For more information on the S503, S904 or Optical humidity generators please contact Michell Instruments (see contact details at www.michell.com).

3.1 Calibration & Adjustment for 3% Accuracy (1pt Adjustment)

WM33

1.

Unscrew the four bayonet screws on the front panel.
2.

Remove the front panel.
- The transmitter should be calibrated at one point, for example 50% RH.

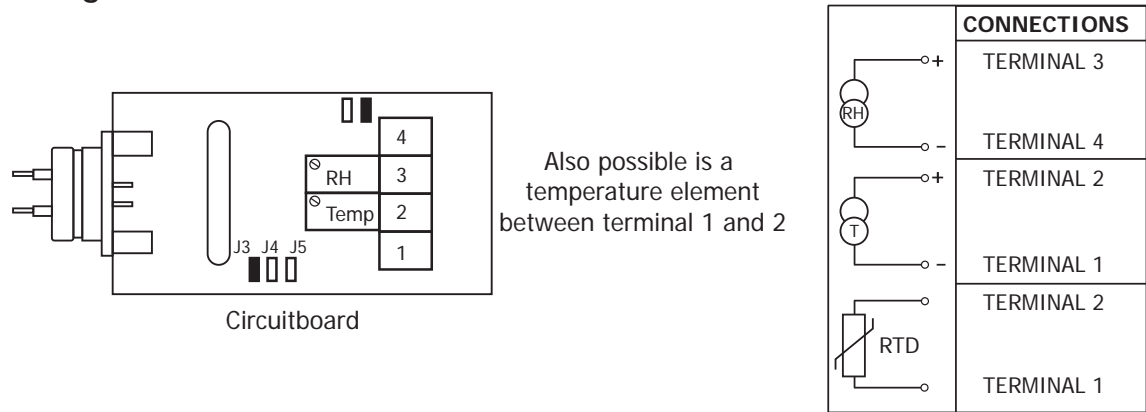
Once this value is reached and the reading of the reference has stabilized, adjust the transmitter with the RH potentiometer.

For versions with a T output the temperature should be calibrated at ambient temperature.

After stabilizing, adjust with the temperature potentiometer.

See *Figure 3* for 2-wire 4-20 mA output, and *Figure 4* for 3/4-wire voltage output (0-1, 0-5 or 0-10 V).

2-wire (mA)
Analog

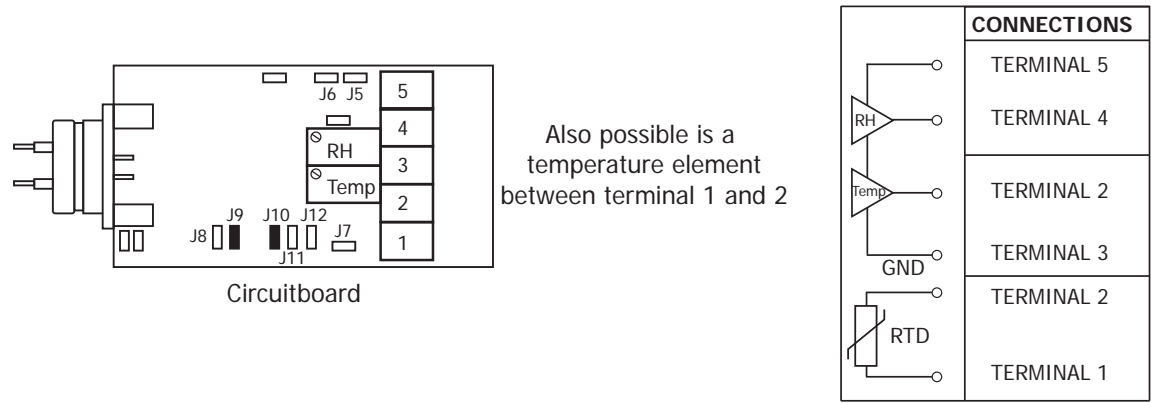


TEMPERATURE RANGE			
Input	J3	J4	J5
0 to +50°C (+32 to +122°F)	●	●	●
0 to +100°C (+32 to +212°F)	●		
-20 to +80°C (-4 to +176°F)		●	

● Soldered joint

Figure 3 WM33 - 2-wire Connection

3/4-wire (Volt)
Analog



REL HUMIDITY OUTPUT		
	J5	J6
0 - 1 V DC	●	
0 - 5 V DC		●
0 - 10 V DC		

● Soldered joint

TEMPERATURE RANGE / OUTPUT																		
Output	0 to +50°C (+32 to +122°F)						0 to +100°C (+32 to +212°F)						-20 to +80°C (-4 to +176°F)					
	J7	J8	J9	J10	J11	J12	J7	J8	J9	J10	J11	J12	J7	J8	J9	J10	J11	J12
0 - 1 V DC	●		●			●	●		●	●			●	●		●		
0 - 5 V DC			●	●					●					●				
0 - 10 V DC			●		●				●	●				●		●		

● Soldered joint

Figure 4 WM33 - 3/4-wire Connection

3.2 Calibration & adjustment for 2% accuracy (2 pt adjustment)

WM52

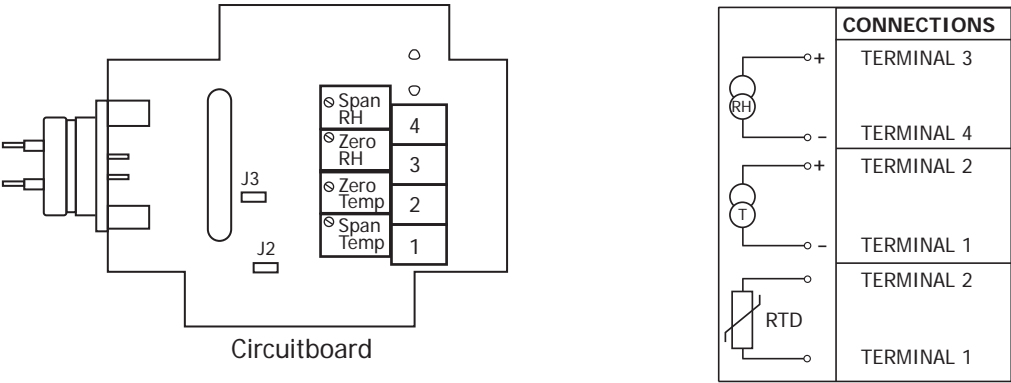
1.

Unscrew the four bayonet screws on the front panel.
2.

Remove the front panel.
- The transmitter should be calibrated at two points, one low (Zero) and one high (Span) point.
- Once the first low value is reached and the reading of the reference is stabilized, adjust the transmitter with the Zero RH potentiometer. Compare with the reference.
- After the second high value is reached and stabilized, adjust with the Span RH potentiometer.
- For versions with a T output this procedure should be repeated with a temperature potentiometer - only use the 'Zero temp' potentiometer to adjust the temperature readings.

See *Figure 5* for 2-wire 4-20 mA output, and *Figure 6* for 3/4-wire voltage output (0-1, 0-5 or 0-10 V).

2-wire (mA)
Analog

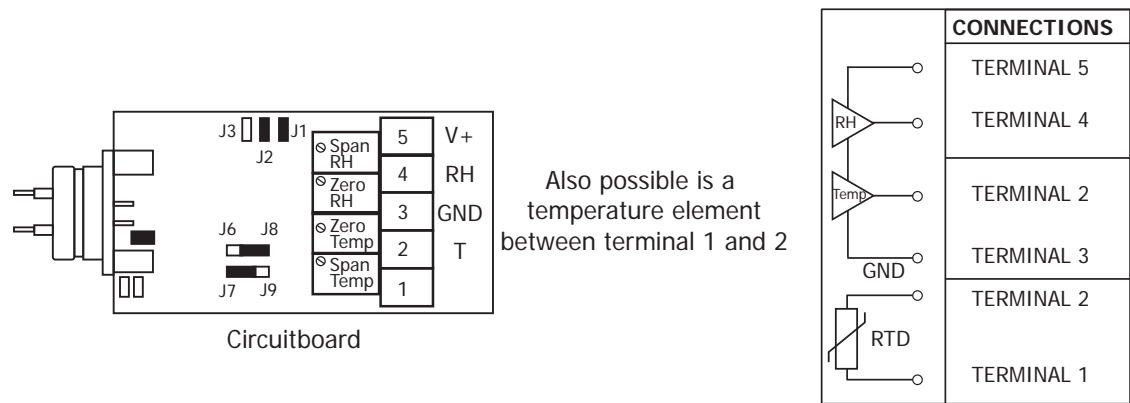


TEMPERATURE RANGE		
Input	J2	J3
0 to +50°C (+32 to +122°F)	●	
0 to +100°C (+32 to +212°F)		
-20 to +80°C (-4 to +176°F)		●

● Soldered joint

Figure 5 WM52 - 2-wire Connection

3/4-wire (Volt)
Analog



REL HUMIDITY OUTPUT			
	J1	J2	J3
0 - 1 V DC	●		
0 - 5 V DC			●
0 - 10 V DC	●	●	

● Soldered joint

TEMPERATURE RANGE / OUTPUT												
	0 to +50°C (+32 to +122°F)				0 to +100°C (+32 to +212°F)				-20 to +80°C (-4 to +176°F)			
Output	J6	J7	J8	J9	J6	J7	J8	J9	J6	J7	J8	J9
0 - 1 V DC						●			●	●		
0 - 5 V DC		●	●					●	●			●
0 - 10 V DC			●			●	●		●	●	●	

● Soldered joint

Figure 6 WM52 - 3/4-wire Connection

3.3 Calibration and Adjustment for Digital Board Version

3/4-wire (Volt) with display
Digital

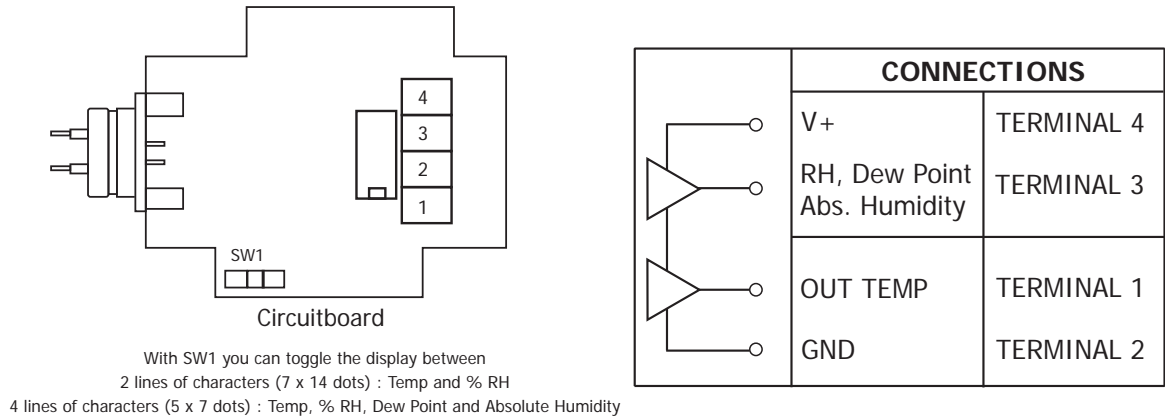


Figure 7 3/4-Wire (with Display) Connection

For calibration and adjustment contact your local Michell Instruments’ distributor.

Appendix A

Technical Specifications

Appendix A Technical Specifications

Performance	
Measurement Range (RH)	0-100% RH
Measurement Range (T)	-20 to +80°C (-4 to +176°F)
Accuracy at 23°C (73°F) Humidity	WM52: <±2% RH (10-90% RH) WM33: <±3% RH (30-80% RH)
Accuracy at 23°C (73°F) Temperature	WM52: ±0.2°C (±0.36°F) WM33: ±0.3°C (±0.54°F)
Stability - RH Sensor	±1% RH/year
Response time - RH Sensor	<10 sec typical (for 90% of the step change)
Electrical output/input	
Output Signal	4-20 mA, 0-1, 0-5, 0-10 V
Supply Voltage	14-30 V DC (0-5, 0-10 V output) 5-30 V DC (0-1 V & 4-20 mA output)
Operating conditions	
Operating Humidity Probe, Housing, Storage	5-95% RH non-condensing
Operating Temperature Probe, Housing	-30 to +85°C (-22 to +185°F) With display: -20 to +70°C (-4 to +158°F)
Storage	-40 to +85°C (-40 to +185°F) With display: -30 to +80°C (-22 to +176°F)
PRT	
Measurement Range	Pt100/1000: -50 to +200°C (-58 to +392°F)
Accuracy	Pt100/1000: ±0.15°C
Mechanical Specification	
Housing Material	White molded polymer
Ingress Protection	IP65 rated
Weight	82g (2.89oz)
Electrical Connections	Screw terminals
Alternative Outputs	
Dew Point	-40 to +60C (-40 to +140F)
Absolute Humidity	0 to 200 g/m ³ (0 to 87.4 gr/ft ³)

A.1 Dimensions

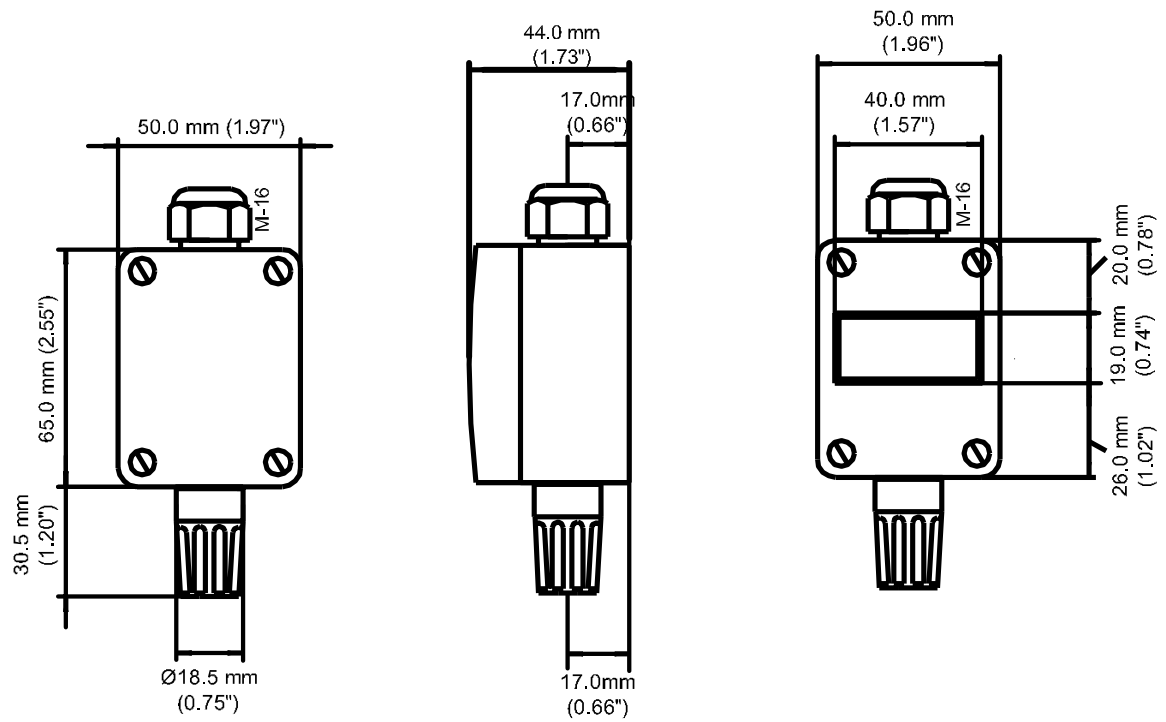
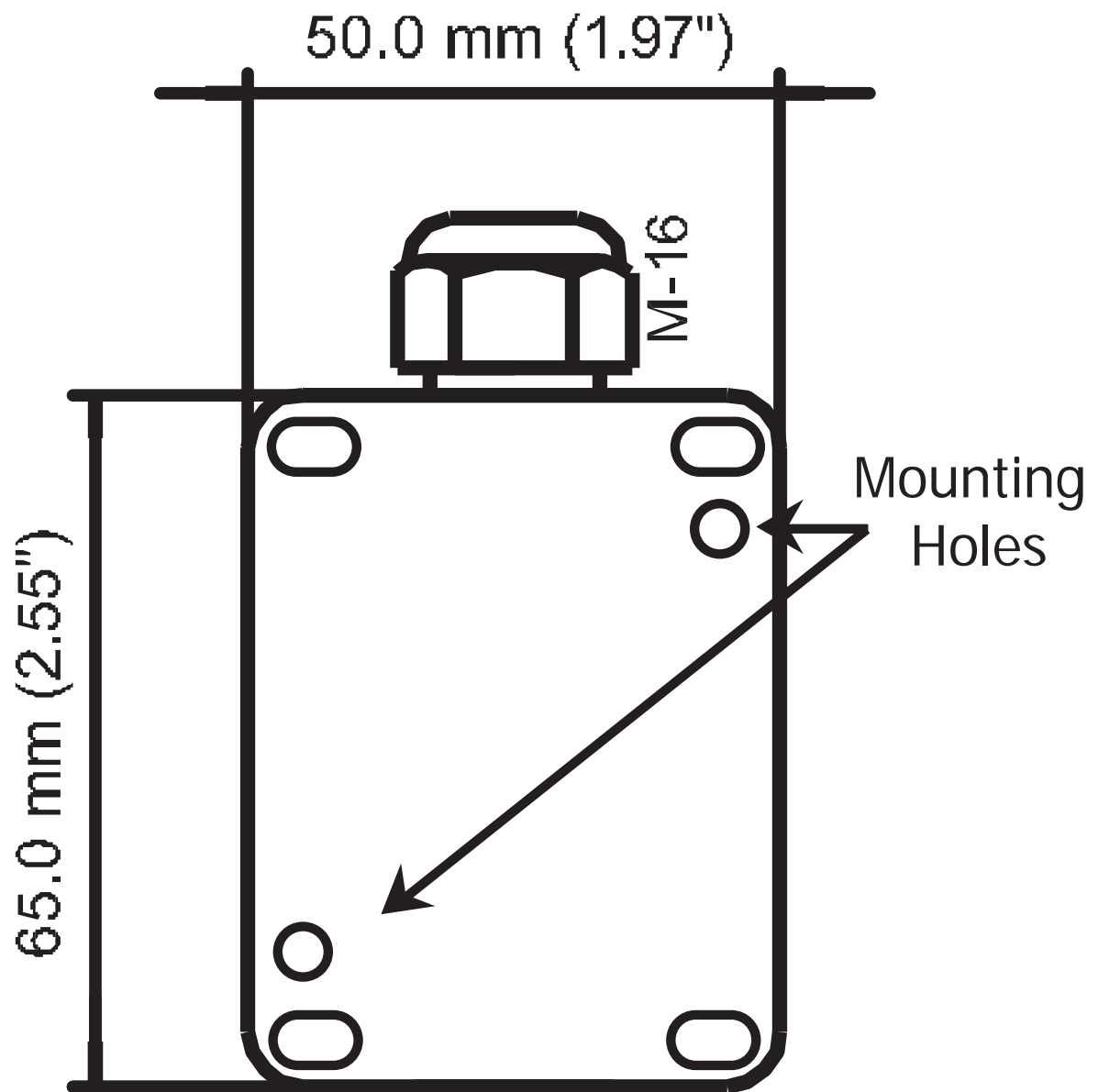


Figure 8 Dimensions



This drawing is actual size and can, therefore, be photocopied and used as a template when mounting the instrument.

Figure 9 *Template*

Appendix B

EC Declaration of Conformity

Appendix B EC Declaration of Conformity

B.1 WM33

EC Declaration of Conformity



Manufacturer: Michell Instruments B.V.
Krombraak 11
4906 CR Oosterhout
Netherlands.



We declare under our sole responsibility that the product:

WM33 RH & Temperature Transmitter

complies with all the essential requirements of the EC directives listed below.

2004/108/EC **EMC Directive**

Using the standards:

EN61326-1:2006 **Electrical equipment for measurement, control and laboratory use – EMC requirements – Group 1, Class B (emissions) and immunity.**

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

EN61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

A handwritten signature in black ink, appearing to be 'P. Haakma', written over a horizontal line.

Peter Haakma, Managing Director Michell Instruments B.V.
Date of Issue: November 2012

B.2 WM52

EC Declaration of Conformity



Manufacturer: Michell Instruments B.V.
Krombraak 11
4906 CR Oosterhout
Netherlands.



We declare under our sole responsibility that the product:

WM52 RH & Temperature Transmitter

complies with all the essential requirements of the EC directives listed below.

2004/108/EC

EMC Directive

Using the standards:

EN61326-1:2006

Electrical equipment for measurement, control and laboratory use – EMC requirements – Group 1, Class B (emissions) and immunity.

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

EN61010-1:2010

Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

A handwritten signature in black ink, appearing to be 'P. Haakma', written over a horizontal line.

Peter Haakma, Managing Director Michell Instruments B.V.
Date of Issue: November 2012

B.3 WM52 with Display

EC Declaration of Conformity



Manufacturer: Michell Instruments B.V.
Krombraak 11
4906 CR Oosterhout
Netherlands.



We declare under our sole responsibility that the product:

WM52 with Display RH & Temperature Transmitter

complies with all the essential requirements of the EC directives listed below.

2004/108/EC **EMC Directive**

Using the standards:

EN61326-1:2006 **Electrical equipment for measurement, control and laboratory use – EMC requirements – Group 1, Class B (emissions) and immunity.**

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

EN61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

A handwritten signature in black ink, appearing to be 'P. Haakma', written over a horizontal line.

Peter Haakma, Managing Director Michell Instruments B.V.
Date of Issue: November 2012

Appendix C

Quality, Recycling & Warranty Information

Appendix C Quality, Recycling & Warranty Information

C.1 Pressure Equipment Directive (PED) 97/23/EC

The above Directive has been implemented in United Kingdom Law by the Pressure Equipment Regulations 1999.

The Regulations require that all pressure equipment and assemblies within the scope of the Pressure Equipment Directive must be safe when placed on the market or put into service.

Michell Instruments' products have been assessed and, as referenced against the Classification Charts detailed in Annex II of the Directive, do not fall into the requirements for CE marking compliance with the Pressure Equipment Directive.

Article 3, paragraph 3 states that any product containing a pressurized fluid that does not qualify for compliance should, nevertheless, be constructed with Sound Engineering Practice (SEP).

Michell Instruments attests here that its products have been designed, manufactured & tested to assure safe operation, and in accordance with Sound Engineering Practices.

C.2 Recycling Policy



Michell Instruments is concerned with the protection of the environment. It is our commitment to reduce and eliminate from our operations, wherever possible, the use of substances which may be harmful to the environment. Similarly, we are increasingly using recyclable and/or recycled material in our business and products wherever it is practical to do so.

To protect natural resources and to promote material reuse, please separate batteries from other types of waste and recycle responsibly. If batteries are not properly disposed of, these substances can cause harm to human health and the environment.

The product that you have purchased may contain recyclable and/or recycled parts and we will be happy to provide you with information on these components if required. For further information please see the following sections.

C.3 WEEE Compliance

Directive 2012/19/EU 4 July 2012 on Waste Electronic and Electrical Equipment (WEEE)

The Waste Electronic and Electrical Equipment (WEEE) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

Michell Instruments is in full compliance with the WEEE Directive and is registered with an approved recycler (Registration No. WEE/JB0235YW) and treats the requirement of the directive and the protection of the environment with the utmost importance. All Michell Instruments' products are appropriately marked indicating their requirement for recycling.

It may be required to return certain instruments for treatment at the end of their working life.

Feb 2013

C.4 RoHS2 Compliance

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011

The Restriction of Hazardous Substances (RoHS) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

According to the EC Directive 2002/95/EC, Michell Instruments' products qualify as Category 9, Control and Monitoring Equipment. Under the 2002/95/EC Directive, Category 9 products are exempt from compliance with the Directive.

However, the careful design of all Michell Instruments' products takes into consideration the requirements of the Directive and, wherever possible, compliance is achieved. All future products will be developed entirely using compliant materials. Furthermore, Michell Instruments is taking active steps to remove non-compliant materials and components from existing products wherever these may occur. Presently, none of the non-compliant materials are known to occur in Michell Instruments' products.

The new Directive 2011/65/EU (RoHS2) entered into force on 21 July 2011 and required all Member States to transpose the provisions into their respective national laws by 2 January 2013.

Under the provisions of the RoHS2 EU Directive 2011/65/EU (Article 3, [24]) defines 'Control and Monitoring Equipment' specifically as 'monitoring and control instruments designed exclusively for industrial or professional use'.

RoHS2 EU Directive 2011/65/EU states the closing date for compliance of any Control and Monitoring Equipment product sold into the EU market place as 22nd July 2017.

However, the careful design policy of all Michell Instruments' products continues to attain compliance in the shortest practical timescales and strives to ensure that less than 0.1% of total mass per product, of all non-compliant materials, appear within them. Michell Instruments continues to monitor suppliers and material sources to ensure that compliance of goods provided is maintained.

January 2013

C.5 Warranty

Unless otherwise agreed, the Supplier warrants that, as from the date of delivery for a period of 12 months, the goods and all their component parts, where applicable, are free from any defects in design, workmanship, construction or materials.

The Supplier warrants that the services undertaken shall be performed using reasonable skill and care, and be of a quality conforming to generally accepted industry standards and practices.

Except as expressly stated, all warranties whether express or implied, by operation of law or otherwise, are hereby excluded in relation to the goods and services to be provided by the Supplier.

All warranty services are provided on a return to base basis. Any transportation costs for the return of a warranty claim shall reside with the Customer.

C.6 REACH Compliance

Regulation (EC) No. 1907/2006

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Michell Instruments is a manufacturer of moisture measurement and gas analysis instrumentation and is a 'downstream' user of chemicals, as described by the EU Council Directive 76/769/EEC. The products we supply are not raw chemical products (goods).

Under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not contain or release any prohibited chemicals. No listed SVHC (Substances of Very High Concern) appear within products manufactured by Michell Instruments. Therefore the 0.1% mass per product, or total usage of 1 tonne/year, will never be exceeded. For these reasons we are neither required by obligation for registration nor for the creation of material safety data sheets (MSDS) for our products.

Our continued review of the SVHC Candidate List and latest additions is to ensure we remain compliant.

Michell Instruments maintains a hazardous material register in which MSDS data sheets are collated, and we will check that our suppliers will comply to REACH requirements for all materials and substances we use in the processes of our manufacturing.

In the unlikely event that any chemicals of concern appear in our products in quantities greater than 0.1% of total mass per product we will immediately inform you by correspondence according to the REACH Article 33 requirements. Our current appraisal is, however, that we do not expect or foresee such an incidence.

January 2013

C.7 Calibration Facilities

Michell Instruments' calibration facilities are among the most sophisticated in the world and have been recognized for their excellence.

Traceability to the National Physical Laboratory (NPL) UK is achieved through our UKAS Accreditation (Number 0179). This covers dew point over the range -90 to +90°C (-130 to +194°F) and also Relative Humidity.

Dew-point calibrations are also traceable to the National Institute for Standards & Technology (NIST) USA over the range -75 to +20°C (-103 to +68°F).

NOTE: Standard traceable calibration certificates for instruments and sensors are not issued under our UKAS accreditation. UKAS certificates are usually to special order and are clearly identified.

C.8 Return Policy

If a Michell Instruments' product malfunctions within the warranty period, the following procedure must be completed:

1. Notify a Michell Instruments' distributor, giving full details of the problem, the model variant and the serial number of the product.
2. If the nature of the problem indicates the need for factory service then the instrument should be returned to Michell Instruments, carriage prepaid, preferably in the original packaging, with a full description of the fault and the customer contact information.
3. Upon receipt, Michell Instruments will evaluate the product to determine the cause of the malfunction. Then, one of the following courses of action will be taken:
 - If the fault is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
 - If Michell Instruments determines that the fault is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs, at standard rates, will be provided. Upon receipt of the owner's approval to proceed, the product will be repaired and returned.

C.9 Manufacturing Quality

Michell Instruments is registered with the British Standards Institute for Quality Assurance to:

BS EN ISO 9001: 2008

Rigorous procedures are performed at every stage of production to ensure that the materials of construction, manufacturing, calibration and final test procedures meet the requirements laid down by our BSI approved Quality System.

Please contact Michell Instruments (www.michell.com) if the product does not arrive in perfect working order.

Appendix D

Recommended Practices in Humidity Measurement

Appendix D Recommended Practices in Humidity Measurements

The following text is reproduced with kind permission from the National Physical Laboratory. It is originally published in the booklet, *A Guide to the Measurement of Humidity*.

Definition of Relative Humidity

Relative Humidity - The ratio of the actual vapor pressure to the saturation vapor pressure over a plane liquid water surface at the same temperature, expressed as a percentage. This is commonly understood when the term 'X percent relative humidity' is used.

For actual vapor pressure, e , and saturation vapor pressure, e_s

$$\text{relative humidity (in \%)} = \frac{e}{e_s} \times 100$$

USAGE: The phrase 'relative humidity' is commonly abbreviated RH although this is not a recognized abbreviation. Values of relative humidity are commonly expressed in units of percent relative humidity (% RH).

Recommended practices in humidity measurements

General practical recommendations

- Where relative humidity is of interest, a direct measurement of relative humidity is usually best. Where an absolute measure of humidity is needed, choose dew point, vapor pressure or similar measurements.
- Establish the measurement requirements at the purchasing stage in order to have the right instrument for the job.
- Allow hygrometers to equilibrate in any new environment. This is particularly necessary after changes in temperature due to transportation or storage. Depending on the instrument and on how great the change in conditions, this may require from only a few minutes to many hours.
- Follow Michell Instruments' care instructions for the instrument. Some instruments need routine cleaning or other maintenance. Before using any solvent cleaner, check with Michell Instruments that this will not harm the sensor or other materials of construction.
- Wherever possible, ensure that hygrometers are calibrated under the conditions of use, i.e. at similar values of humidity and temperature, and (if relevant) in similar conditions of pressure, airflow, etc.
- Keep a record of calibrations and any adjustments to the hygrometer. This will show the long-term stability of the instrument and allow the associated uncertainty to be assessed.
- Check instruments, if possible, at intervals between calibrations, by comparison with another (stable) instrument, to monitor for long-term drift. Routine checks are also useful before and after subjecting an instrument to transportation or other stress, which might lead to a shift in its performance. Where the check is against two (or more) instruments this is even better: not only does this add confidence, but in the event of one instrument drifting among a set of three, it can be seen which reading is most suspect.

- Cleanliness of the environment will affect different hygrometers in different ways. Dust and airborne droplets should be avoided or filtered out if possible. Contaminants can come from the most surprising sources, ordinary urban pollution, for example.
- The readings given by some types of hygrometer are sensitive to gas type. For any Instrument which reads in terms of mass per unit volume, e.g. in grams per cubic metre, it must be confirmed whether the calibration is valid for the gas in use.
- Avoid using instruments in direct sunlight or near any other source of heat, unless they are suitably shielded to prevent measurement errors.

Sampling in general

- Relative humidity measurements should be carried out at a representative temperature. Failure to allow temperature equilibration will lead to a false indication of the relative humidity.
- Variations in vapor pressure from place to place can occur where an environment is subject to any addition or removal of water. If so, care must be taken over where to make a measurement in order to obtain a representative result.
- Sources and sinks of water vapor should be avoided in any sampling system. Invasion of stray water can be minimised by attention to leaks, hygroscopic materials, droplets and condensation. The lower the humidity, the more critical these precautions are.
- Hygroscopic materials should be avoided. Many materials contain moisture as part of their structure, particularly organic materials (whether natural or synthetic), salts (or anything which contains them), and anything which has small pores. Temperature changes can increase the tendency of these materials to affect the humidity of the surrounding air.
- Condensation in a sampling process can invalidate humidity measurements by reducing the water content of the gas being measured. What is more, condensed liquid may alter the humidity elsewhere by dripping or running to other locations and evaporating there. In these circumstances, measurement results may be misleading if hygrometer location is not considered carefully.
- Water droplets or mist must be avoided. These can result in overestimates of the humidity of the air between the droplets. Such results may exceed 100% RH, or may be impossible to interpret meaningfully. Droplets of liquid also damage some electrical types of humidity sensor. Filtering the air sample can eliminate droplets.
- If pumps are used for sampling gas, these should be located after the hygrometer, to avoid contaminating the measurement environment. Where possible, oil free pumps should be used, or filters employed. Oscillations in pressure due to pumping can sometimes be reduced or buffered using a needle valve or a reservoir of large volume.
- Special treatments such as filtration can change the amount of moisture in a gas. Some drying agents take out other gases too.
- When sealing any sensor or probe into a port or manifold in a duct or chamber, leaks through the probe or electrical cable should be considered. These are not always sealed against passage of ambient air.
- Where sampling involves a step change in temperature, pressure or gas flow rate, relative to the process being sampled, results may need to be converted or interpreted. For example 'pressure dew point' will differ from the value found after expanding the gas sample to atmospheric pressure. Care should be taken to distinguish between 'gauge' and absolute values of pressure.

Dew point in general

- The measuring environment and all parts of the sampling pathway must be kept above the dew point if condensation is to be avoided. Electrical trace heating or other heating methods should be used if necessary. An excess temperature of 10°C above the dew point is usually a safe margin.
- For measurements in the region below 0°C it must be clear whether the condensate is dew or frost. Failure to distinguish between these can result in errors of about 1°C for every 10°C below zero.

Relative humidity in general

- Due care must be taken of temperature. The effect of temperature on humidity is highly significant. Failure to take this into account can sometimes lead to errors so large that the measurement is meaningless. In many situations, the largest single source of uncertainty in a humidity measurement is the effect of temperature differences from place to place in the process, room or chamber. The importance of considering the temperature effects carefully cannot be overstated when relative humidity is the parameter of interest.
- Care must be taken when expressing uncertainties, changes or fractional differences in relative humidity. For example, the difference between 50% RH and 52% RH is 2% RH. This can also be expressed as a difference of 4% of value. It is important to distinguish clearly between these two kinds of statement.

Recommendations specific to ranges of measurements

- Ambient humidity - Avoid using hygrometers near the body, which is a source of heat and moisture. Do not breathe close to the measurement.
- High humidity, above the ambient range - Ample lines should be maintained above the dew point of the gas being measured, to avoid condensation. Electrical trace heating is often the most practical method.
- Low humidity, and very dry gases - If possible, prepare for measurements by flushing sample lines and hygrometers with dry gas, or by evacuating to low pressure. Drive off stray residual water by baking assemblies if possible (but not instruments - unless designed for this!). The lower the moisture content to be measured, the more dramatically the required drying time multiplies.
- Avoid hygroscopic materials. At low humidity (anything much below a dew point of 0°C) the amounts of water given off by organic and porous materials can dramatically affect the value of humidity. The lower the level of moisture, the more significant the effects.
- Choose impermeable materials, to avoid inward diffusion of moisture through sampling tubes and enclosures. Steel and other metals are practically impermeable. PTFE ('Teflon') is only slightly permeable and will usually be satisfactory for dew points above -20°C, and sometimes below this level. Materials such as PVC and rubber are relatively permeable and so totally unsuitable at low humidity, and not really satisfactory in any humidity range.
- Surface finish of pipework is important for very dry gases. Even the tiny quantities of water adsorbed on the surfaces of non-hygroscopic materials can have significant effect. Polished or electropolished steel is recommended for the best results.

- Clean environments are always best for humidity measurements, but this is especially critical at very low humidity. Even fingerprints harbour water. High purity cleaning agents are recommended: Analytical Reagent (AR) quality solvents for oil-based contaminants, and purified water (distilled or de-ionised) for salts. Cleaning should be followed by thorough drying by a clean method.
- Sample tubing should be as short in length as possible. The surface area should be minimised by using the narrowest tubing that the flow conditions will permit.
- Avoid leaks. Minimising the number of connections (elbows, tees, valves, etc.) helps with this.
- Adequate flow of the gas sample should be ensured, to minimise the influence of sources of stray water in the flow path.
- 'Dead ends' should be avoided, as they cannot easily be flushed.
- Back-diffusion of moisture should be minimised, e.g. by fast flow rates of gas, long exhaust tubes after the sensor, or by valves which isolate the low-humidity region from ambient air.

Practical recommendations for specific types of hygrometer

Relative humidity capacitive sensor

- Care should be taken to avoid mechanical shock (impact) or thermal shock (sudden temperature changes). Sensors should be protected from steam or water sprays, and from direct sunlight.
- Where a sensor is at risk of exposure to dust, droplets, or the occasional knock during handling, the appropriate guard or filters for the sensor head should be used.
- Any temptation to breathe on the sensor, or to wave it over cups of tea, etc. should be resisted. Filters and saturation guarding may protect the sensor, but these actions carry a risk of damage by condensation or other contamination.
- Protective filters can slow the response time of sensors. This can be avoided by removing any filter, but the benefit must be weighed against the risk of damage to the sensor.
- Sensors should not normally be submerged in liquids. In the case of a resistive (electrolytic) sensor, water or other liquids would certainly damage the sensor beyond repair.
- Salt solutions are especially commonly used for calibration of electrical sensors, and should be provided with traceability directly or via a calibrated hygrometer. Protection of sensors from direct contact with salt or solution is most important as contamination would destroy or seriously impair the sensing element.

Appendix E

Return Document & Decontamination Declaration

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Decontamination Certificate

IMPORTANT NOTE: Please complete this form prior to this instrument, or any components, leaving your site and being returned to us, or, where applicable, prior to any work being carried out by a Michell engineer at your site.

Instrument			Serial Number	
Warranty Repair?	YES	NO	Original PO #	
Company Name			Contact Name	
Address				
Telephone #			E-mail address	
Reason for Return /Description of Fault:				
Has this equipment been exposed (internally or externally) to any of the following? Please circle (YES/NO) as applicable and provide details below				
Biohazards	YES		NO	
Biological agents	YES		NO	
Hazardous chemicals	YES		NO	
Radioactive substances	YES		NO	
Other hazards	YES		NO	
Please provide details of any hazardous materials used with this equipment as indicated above (use continuation sheet if necessary)				
Your method of cleaning/decontamination				
Has the equipment been cleaned and decontaminated?	YES		NOT NECESSARY	
Michell Instruments will not accept instruments that have been exposed to toxins, radio-activity or bio-hazardous materials. For most applications involving solvents, acidic, basic, flammable or toxic gases a simple purge with dry gas (dew point <-30°C) over 24 hours should be sufficient to decontaminate the unit prior to return. Work will not be carried out on any unit that does not have a completed decontamination declaration.				
Decontamination Declaration				
I declare that the information above is true and complete to the best of my knowledge, and it is safe for Michell personnel to service or repair the returned instrument.				
Name (Print)			Position	
Signature			Date	



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NOTES:

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